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Identifying Sources of Fecal Coliform Bacteria in Accotink Creek

A cooperative study between the USGS, the Virginia Department of Environmental Quality (DEQ), the Department of Conservation and Recreation (DCR), and Fairfax County

Occurrence and sources of fecal coliform bacteria in stream water

Contamination of streams by fecal coliform bacteria is a major cause of water-quality violations throughout the Nation. In Virginia, of the 301 impaired stream and river segments on the Commonwealth's priority list, 179 are listed for violations of the fecal coliform bacteria standard. One of these impaired streams, Accotink Creek, is in Fairfax County. The creek is in an urban watershed that also contains abundant forested areas and a thriving wildlife population.

Although fecal coliform bacteria are not necessarily dangerous to humans, their presence in streams indicates that the water is contaminated with fecal waste from warm-blooded animals (such as humans, domestic livestock, pets, and wildlife). For this reason, fecal coliform bacteria are known as "indicator organisms"; their presence in recreational waters indicates an increased risk to human health. Drinking or contacting water that is contaminated with fecal waste can make you sick because of the other bacteria, viruses, and pathogens that may be present. To safeguard human health, a water-quality standard of 1000 bacteria colonies per 100 milliliters of water sample has been developed for recreational waters.

DEQ and the Fairfax County Department of Health monitor the water quality of Accotink Creek. Data from both organizations indicate that fecal coliform bacteria frequently impair Accotink Creek.

One of the major obstacles to improving stream water quality is that the potential sources of fecal coliform bacteria are numerous and the dominant sources are generally unknown. This makes it difficult to direct effective cleanup efforts. Based on a desire to improve the water quality of Accotink Creek, the USGS initiated a study in 1999 to investigate:

1. What are the concentrations of fecal coliform bacteria during different flow conditions?
2. What are the sources of the fecal coliform bacteria that are impacting Accotink Creek?

What is the USGS doing to address these concerns?

To find out how fecal coliform concentrations vary during different flow conditions, the USGS monitored fecal coliform bacteria at different locations in Accotink Creek. Fecal coliform concentrations were collected:

1. During base flow (low flow) conditions at Braddock Road (the water-quality compliance point)
2. During storm events at Braddock Road
3. At a total of 5 sites along the length of Accotink Creek

Fecal coliform samples from the Braddock road site were also subjected to a genetic fingerprinting analysis known as **ribotyping**. This technique allows us to determine the sources of the fecal coliform bacteria that are impairing Accotink Creek. The ribotyping technique is actually performed on *E. coli* bacteria, which are the dominant members of the fecal coliform bacteria group. The ribotyping technique works because each warm-blooded animal species possess genetically unique *E. coli*, and ribotyping can characterize these genetic differences. The ribotyping analysis isolates and characterizes a specific portion of the *E. coli* DNA (the gene that codes for ribosomal RNA production); this specific gene is then compared to *E. coli* genes from known animals. We developed the library of known *E. coli* fingerprints by collecting and sampling the fecal waste (which contains species-specific *E. coli*) from the potentially contributing animal species such as dogs and geese. The entire ribotyping process is analogous to comparing a fingerprint from a crime scene (the unknown) with a police department's fingerprint database (a library of known fingerprints).

Isolating the Ribosomal RNA Gene